

<sup>2</sup> Humatics is aware of the ongoing Commission proceeding concerning the 3700-4200 MHz band and its potential future use for 5G services. *See, e.g., Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Order and Notice of Proposed Rulemaking, GN Docket No. 18-122, 33 FCC Rcd 6915 (2018). Humatics understands and acknowledges that UWB equipment is governed by Part 15 requirements to protect licensed services from harmful interference and must accept any interference from current (or future) primary licensed services. *See* 47 C.F.R. §15.5.

existing technologies cannot feasibly operate and promotes workplace safety by allowing for precise, positive identification of personnel in remote and potentially hazardous environments.

## **I. BACKGROUND.**

### **A. Humatics Corporation.**

Humatics, founded in 2015, is a U.S.-based manufacturer headquartered in Waltham, MA with an engineering center of excellence in Huntsville, AL. The company, which owns over 100 innovative patents, is pioneering microlocation technology with its Humatics Spatial Intelligence Platform. Humatics offers centimeter-scale positioning that is more precise than any location tracking technology on the market. In early 2018, Humatics acquired 5D Robotics and its subsidiary, Time Domain, a leader in the development of technologies that provide extremely accurate positioning and navigation. Humatics' legacy Time Domain products have been deployed globally, including within the U.S., for use cases that are governed by the Commission's existing UWB rules. Humatics' Spatial Intelligence Platform, which incorporates the Time Domain technology, has recently been made available to global customers and broader deployment is anticipated in 2019.

### **B. Spatial Intelligence Platform Applications.**

The Humatics Spatial Intelligence Platform better enables people and machines to locate, navigate, and collaborate in the connected world. Humatics is targeting its Spatial Intelligence Platform at industrial logistics and manufacturing markets, including factories, ports, and warehouses, where high precision can dramatically improve performance and safety. Within these tough industrial environments, the platform can be used to unlock new possibilities for industrial microlocation applications such as:

- Automatic Guided Vehicle (“AGV”) Navigation – dynamic routing, moving between loading cranes and container staging areas, functioning in all weather conditions, navigating long/narrow aisles, and adapting to open loading dock areas;

- Crane Control – precise placement of containers onto trucks and AGVs, from manufacturing assembly to container yard;
- Forklift Tracking – increased safety, geo-fencing for credential access, and location-based tool usage; and
- Worker Tracking – increased safety and geo-fencing for credential access. For access control, evacuation assurance, and ensuring people are not around so equipment can move more efficiently.

### **C. Inadequacy of Alternative Technology.**

Humatics' customers in the industrial logistics and manufacturing markets face challenges that are not adequately addressed by existing technologies on the market. While magnetic tape and inductive wire/RFID provide an accurate and low-cost tracking solution, these technologies have significant limitations, including the lack of dynamic routing (a robot or vehicle must be over the sensor to work), significant maintenance requirements (tape and sensors wear away), especially in gritty, outdoor environments, and the need for additional sensors for safety (increasing costs). Additionally, while 2-D LIDAR provides a weather resistant solution that can accommodate light, it cannot tolerate floor height changes greater than 2 centimeters and does not perform well in dynamic environments. 3-D LIDAR, while improving, is not safety rated due to complexity, processing, and regulations and is significantly more expensive than 2-D LIDAR. Finally, GPS RTK offers a reliable tracking system in outdoor environments, but cannot be used in all-weather situations or near buildings and metal due to multipath interference.

While these and other tracking and navigation technologies are available, they do not address many of the challenges faced by industrial logistics and manufacturing customers for a variety of reasons including, but not limited to, their inability to withstand gritty industrial environments and all-weather conditions and incapability to perform on a dynamic and complex

route. The Humatics Spatial Intelligence Platform, on the other hand, provides unprecedented precision in tough industrial environments and is uniquely able to withstand the gritty environments of industrial customers, both indoor and outdoor, with a reliable, durable, cost-effective, and dynamic platform.

#### **D. Spatial Intelligence Platform Specifications.**

The Humatics Spatial Intelligence Platform is comprised of a 1-D and 3-D localization system (currently sold as the KinetIQ 100 and 300, respectively), which offers precision down to 2 centimeters, as well as a scalable, intuitive browser-based software tool that visualizes, monitors, and analyzes the localization system in real-time (currently sold as the KinetIQ OS). Customers can track and monitor the platform on a continuous basis to ensure system health, optimal efficiency, and performance in accordance with industry specifications. An analytics module helps users visualize invaluable location-based data across each installed device over different points in time.

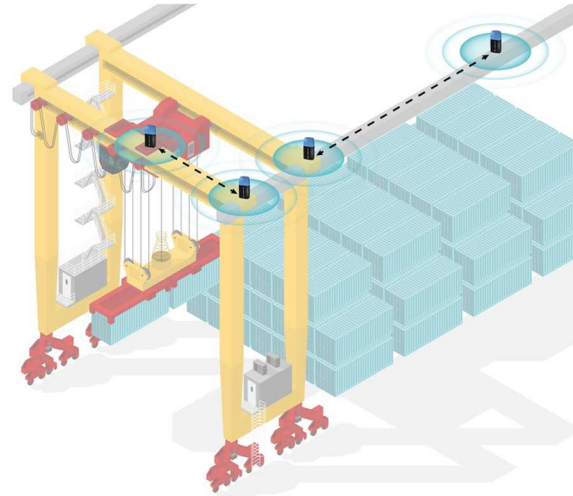
##### **1. 1-D Localization System.**

Measuring distances greater than ten meters in complex industrial environments is a major challenge. Humatics' 1-D ranging technology is the world's most accurate industrial ranging radio, providing centimeter-scale precision with a ruggedized design that is suitable for the most extreme environments. The system uses a two-way time-of-flight ranging technique to provide centimeter-scale distance measurements. The ranging software logs waveform scan data and provides bias adjustment with a patented range quality metric to inform the user of blocked or compromised measurements.

## 1-D Localization System

### Ranger

- 1-D centimeter-scale ranging
- 2cm repeatability
- Superior ranging capabilities for 1D industrial applications



Humatics customers have deployed the 1-D ranging technology to measure critical items, including the linear movement of gantry bridges and hoists, the safe operating distance between rail vehicles, the extension of crane arms and hydraulic cylinders, and the height of industrial lifts and forks on lift trucks.

The deployment of the Humatics 1-D localization system with one of the largest multinational steel producers, headquartered in Mumbai, India, provides an example of the ways in which Humatics' Spatial Intelligence Platform offers a solution to important challenges that alternative technologies fail to adequately address. This Mumbai-based multinational steel producer heavily relies on overhead bridge cranes at steel mills that operate in harsh, high-temperature environments. Optical systems like laser range-finders or typical wireless technologies are not adequate in these environments, as the mean repair time for optical sensors is high and their complexity makes identification of faults and downtime a time-consuming task.

Worker safety is another critical issue for traditional technologies. Operators face dangerous scenarios when operating bridge cranes. Working crews often visit the yards for manual stock updates that result in accidents, injuries, and even fatalities.

In this case, the Mumbai steel producer leveraged a system integrator to increase crane positioning and automation efficiency at its steelyard. The Humatics 1-D localization system was chosen for its highly precise 2 centimeter precision capabilities built for rugged industrial environments, which were used to calculate X-Y position throughout a 400x40 meter steel yard. A crane's position was derived in real-time, and data from the installed units was used to create business rules for stock-in, stock-out and internal mutation, sending work instruction position data to the crane computer's user interface. The Humatics Spatial Intelligence Platform was deployed by the system integrator in a slab yard as well as across all of its steel melting shops. In the melting shops, the 1-D localization system was used to augment an existing vision system in order to improve personnel safety. For the slab yard, the technology was implemented to address productivity and efficiency issues in the customer's active operations.



After 18 months of use at two steel melting yards in Mumbai, India, the Spatial Intelligence Platform is still deployed on cranes handling liquid hot metals without a single reported failure. Utilization of the customer's crane automation system has increased from an average of less than 50 percent when using solely optical sensors to 95 percent by adding Humatics' platform to its solution. Operations managers are now able to focus more on steel stockyard productivity rather than continually worrying about crane asset maintenance and repair scheduling. Meeting the industrial standards to reliably withstand hard environmental conditions is no longer a concern. This deployment illustrates how the Humatics 1-D localization system overcomes hurdles in challenging environmental conditions that other technologies cannot adequately address, and in doing so, provides a safer and more productive work environment for Humatics' industrial logistics and manufacturing customers.

## **2. 3-D Localization System.**

As noted above, object localization and tracking are challenging in industrial environments. The Humatics 3-D localization system unlocks new possibilities for industrial microlocation applications such as AGV navigation for dynamic routing in ports, crane control for precise placement of containers on ships, and tracking workers in a warehouse.

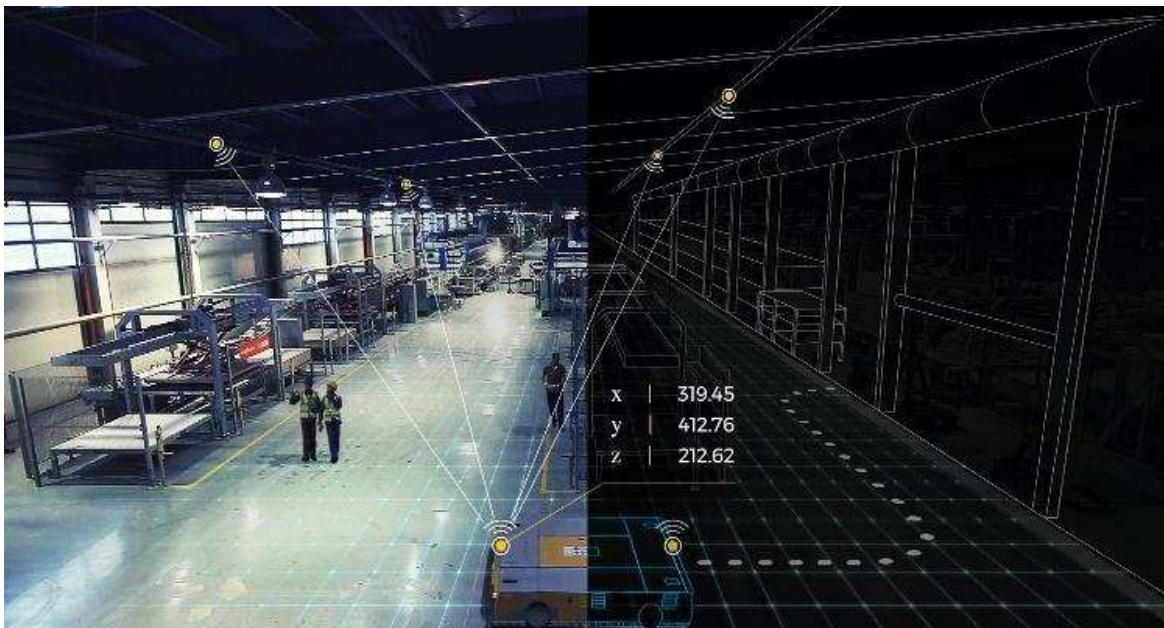
### **3-D Localization System**

Beacon (left image); Navigator Hub & Nodes (right image)

- 3-D centimeter-scale localization
- 2cm repeatability
- World's first ultra-precise 3-D wireless microlocation system for industrial applications



The Humatics 3-D localization system includes powered infrastructure beacons (constellation beacons do not need to be interconnected, unlike alternative systems) that create a mesh network that ranges to any line-of-sight mobiles. The navigator (consisting of two mobile nodes and a mobile hub) and mobile nodes range to the constellation and send the ranges to the mobile hub. The mobile hub then fuses the ranges with onboard sensor data, calculates, and outputs to the controller of the vehicle the X, Y, Z, a heading, and a confidence score. These steps combine to create the innovative tracking process depicted below:



In a recent deployment, Humatics' 3-D localization system was installed in the warehouse of an aircraft assembly manufacturer that was looking to position equipment in a final



aircraft assembly line. The dynamic, open environment prevented LIDAR and magnetic tape from creating a cost-effective, efficient factory where positioning work could be accomplished and autonomous robots could safely work alongside workers and manned vehicles located in the factory. In contrast, the Humatics 3-D localization system was able to perform the functional requirements, which enables the customer to cut down delivery time of materials from logistics to the work station and creating a safe environment for manned vehicles and people to co-exist in the factory setting.

## **II. Request for Waiver.**

The Commission may grant a waiver of its rules if good cause is shown.<sup>3</sup> More specifically, the Commission may grant a request for waiver if it is shown that: (i) the underlying purpose of the rule(s) would not be served or would be frustrated by application to the instant case, and that a grant of the requested waiver would be in the public interest; or (ii) in view of unique or unusual factual circumstances of the instant case, application of the rule(s) would be inequitable, unduly burdensome or contrary to the public interest, or the applicant has no reasonable alternative.<sup>4</sup> As discussed below, Humatics believes that grant of its waiver request: (1) would serve the underlying purpose of the Commission's rules; and (2) would be in the public interest by ensuring enhanced safety and protecting lives and property.

Humatics is seeking a waiver of Section 15.519(a) of the Commission's rules to fully optimize the Spatial Intelligence Platform and to provide maximum benefits as expeditiously as possible to industrial automation and manufacturing markets. Section 15.519(a) specifies that UWB devices operating under this section must be handheld and may not employ a fixed

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<sup>3</sup> See 47 C.F.R. §1.3.

<sup>4</sup> See 47 C.F.R. §1.925(b)(3)(i)-(ii) (setting forth the criteria).

infrastructure.<sup>5</sup> As stated above, Humatics believes grant of its waiver request will not undermine the fundamental purposes of the rule and is in the public interest. Moreover, Humatics' proposed waiver is limited in scope and scaled to industrial environments with professional installation, which creates unique facts that are not contemplated by the current rules. Therefore, application of this rule (restricting use to handheld devices without fixed infrastructure) is inequitable and burdensome without any concomitant benefit.

**A. Section 15.519(a) of the Commission's Rules Should Be Waived to Permit Use of the Humatics Spatial Intelligence Platform.**

The Commission adopted rules for UWB communications systems in 2002 and concluded upon consideration of the record that "UWB technology offers significant benefits for Government, public safety, businesses and consumers."<sup>6</sup> In considering appropriate restrictions, the Commission found "these substantial benefits could be outweighed if UWB devices were to cause interference to licensed services and other important radio operations" and that "UWB devices can be permitted to operate on an unlicensed basis without causing harmful interference provided appropriate technical standards and operational restrictions are applied to their use."<sup>7</sup> To promote UWB's benefits for the government, public safety, business, and consumers while preventing potential interference to licensed services, the Commission adopted Section 15.519(a)'s handheld restriction. In developing this rule, the Commission defined handheld

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<sup>5</sup> See 47 C.F.R. §15.519(a).

<sup>6</sup> See Revision of Part 15 of the Commission's Rules Regarding Ultra WideBand Transmission Systems, ET Docket No. 98-153, *Report and Order*, 17 FCC Rcd 7435 (2002) at ¶4 ("UWB Order").

<sup>7</sup> *Id.*

devices as “portable devices, such as a laptop computer or a PDA, that are primarily handheld while being operated and that do not employ a fixed infrastructure when operating outdoors.”<sup>8</sup>

Described in greater detail above, the Humatics platform consists of UWB microlocation systems located indoors and outdoors that employ fixed infrastructure. Thus, a waiver is needed to permit use of the UWB devices permanently mounted on industrial automation and manufacturing equipment. As an initial matter, all Humatics devices comply with all other applicable UWB rules, such as the EIRP and OOB limits.<sup>9</sup> In addition, all Humatics UWB modules are built upon the already Commission-approved Time Domain module.

**1. Humatics’ Fixed Infrastructure Will Not Create a Risk of Harmful Interference.**

The Commission should issue a waiver that allows Humatics devices to be installed as fixed infrastructure. As noted above, the Commission adopted stringent rules for handheld UWB devices in an abundance of caution to reduce the risk of causing harmful interference to primary services.<sup>10</sup> Consistent with the rule, permitting Humatics’ fixed microlocation systems will not increase this risk of interference. As an initial matter, many of these systems will operate within the indoor confines of industrial logistics and manufacturing facilities, such as factories and warehouses, which will contain the signal and prevent it from reaching outside areas. Additionally, the equipment currently used by Humatics for fixed locations is built upon Time Domain modules certified by the Commission, and has therefore demonstrated compliance with

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<sup>8</sup> *Id.* at ¶20.

<sup>9</sup> *See* 47 C.F.R. §15.517.

<sup>10</sup> UWB Order at ¶18 (noting that the substantial benefits of UWB technology could be outweighed if UWB devices were to cause interference to licensed services and other important radio operations).

the Commission's OOB limits that protect adjacent band services, including GPS.<sup>11</sup> It is also important to distinguish that Humatics' typical operations will exist alongside, not disrupt, existing wireless infrastructure. Because Humatics' UWB devices comply with the Commission's strict OOB rules, there is little risk of harmful interference to any other wireless communications system installed (*e.g.*, Cellular, PCS, AWS, Wi-Fi/Part 15).

Similarly, even when the Humatics platform devices are installed in outdoor locations, like loading docks, the risk of interference to other, primary services remains insignificant. All end-customers will be industrial, commercial operators (Humatics customers will not have consumer deployments), and Humatics has committed that installed infrastructure beacons will be at least 3 meters away from end-user property boundaries. Moreover, Humatics plans to mount infrastructure beacons on customer buildings and existing infrastructure, such as light poles, and refrain from mounting above any existing infrastructure where feasible. Due to the limited operating locations and distance from end-user property boundaries, Humatics' fixed infrastructure will not increase the risk of harmful interference. In addition, all operating beacons will detect and alert for internal and external malfunctions, and all installations will be by Humatics or a professionally certified installer and validated for quality assurance.

Finally, the limitations associated with Section 15.519(a) were designed to ensure that UWB systems were essentially prohibited from creating networks, such as wide area networks, and to limit their deployment to peer-to-peer operations.<sup>12</sup> In this instance, Humatics is not seeking a waiver to create a wide area network—customers will deploy industrial-grade

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<sup>11</sup> Humatics has attached to this waiver request the equipment certification testing for the UWB module that will be used. This report demonstrates that the equipment meets the OOB limits and restricts emissions into the GPS band well below the protection requirements.

<sup>12</sup> UWB Order at ¶5.

equipment in commercial environments that will in fact be peer-to-peer operations. By controlling installations through Humatics or a qualified installer and limiting them to industrial/commercial environments, the requested waiver would not undermine the protections associated with the Part 15 technical rules for such devices. Therefore, the Commission should be assured that the requested waiver would be in the public interest and protect other wireless operations from harmful interference.

## **2. The Humatics Platform Offers a Wide Variety of Public Interest Benefits.**

The Humatics Spatial Intelligence Platform provides significant benefits for Government, public safety, businesses, and industrial customers that outweigh any risk of interference. Without the waiver, current technology limitations will prevent customers from precisely navigating AGVs in complex indoor and outdoor environments; there is no alternative product that currently exists to robustly track high-value assets in metal-heavy areas and accurately locate personnel for operational safety and evacuation within gritty, industrial settings. The carefully crafted Humatics microlocation platform will dramatically improve safety, efficiency, and performance for workers and businesses inside industrial, commercial work sites by: (1) enabling new use cases (autonomous navigation in complex environments) in areas otherwise inaccessible by robotic vehicles; (2) permitting tracking of carts and other high-value assets in locations currently prohibited by existing technology; and (3) allowing for precise, positive identification of personnel in remote and potentially hazardous environments.

## **III. The Requested Waiver Is Consistent with Commission Precedent.**

The Commission has a history of permitting rule waivers when good cause and benefits to the public interest are shown. This is especially true where a waiver promotes safety of life and property, permits innovative solutions, and will not create an increased risk of harmful

interference. The Humatics Spatial Intelligence Platform is consistent with that precedent. A few examples of prior Commission waiver grants that are analogous to the waivers requested here are:

- Amtrak (ET Docket No. 16-415) – In this waiver of the 5 GHz U-NII rules, the Commission permitted Amtrak to operate its point-to-point system to deliver Wi-Fi to moving trains where a radio mounted on a moving train would communicate with trackside fixed transmitters mounted on masts and located along track traversing the Northeast corridor under the rules governing fixed point-to-point systems. The Commission reasoned that such operation was permissible because Amtrak’s operation bore many characteristics of a fixed point-to-point network and that the access points and train-based radios would be exclusively within the bounds of the track right of way and operate in a highly directional manner.<sup>13</sup>
- iRobot Corporation (ET Docket No. 15-30) – In this waiver of the 6 GHz rules, the Commission waived the prohibition on the use of fixed outdoor infrastructure to allow iRobot to obtain equipment certification for and market a robotic lawn mower.<sup>14</sup> The Commission concluded that, when taking into account the variability in propagation characteristics due to terrain, low antenna heights and other propagation factors, grant of this waiver is very unlikely to increase the potential for harmful interference.

The Humatics Spatial Intelligence Platform waiver request should be permitted consistent with the above referenced Amtrak and iRobot orders. The Humatics platform is an innovative and cost-effective solution to improving safety and performance at U.S. industrial, commercial locations, and the use of fixed infrastructure will not increase the potential for harmful interference. As the Commission found when issuing the waivers cited above, the Humatics Spatial Intelligence Platform should be permitted as it promotes safety of life and property and operates within set boundaries with low risk of interference. Indeed, in comparison to the precedents discussed above, the Humatics requested waiver would provide many more benefits

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<sup>13</sup> See Amtrak Request for Waiver, ET Docket No. 16-415, Letter from Julius P. Knapp, Chief, Office of Engineering and Technology, FCC to Robert D. Primosch, Counsel for Amtrak dated Jun 1, 2017, 32 FCC Rcd 4592 (2017).

<sup>14</sup> See iRobot Corporation Request for Waiver of Section 15.250 of the Commission's Rules, ET Docket No 15-30, Order, 30 FCC Rcd 8377 (2015).

to the public—as it will help protect the employees and property in industrial environments rather than simply providing more convenient services. Therefore, the Commission should conclude here that a grant of waiver for the Humatics Spatial Intelligence System is in the public interest.

#### **IV. Conclusion.**

Grant of Humatics’ requested waiver of Section 15.519(a) will promote the public interest by permitting the use of cutting-edge microlocation technology that promotes safety, efficiency, and performance within industrial, commercial operator facilities. At the same time, the requested waiver will not undermine the purpose of Section 15.519(a) and presents unique facts that render application of the UWB operational restrictions inequitable and burdensome without providing any additional interference protection to the public. Accordingly, Humatics respectfully urges the Commission to expeditiously review and approve this request for waiver.

Respectfully Submitted,

/s/ David Mindell

David Mindell  
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July 15, 2019

cc: Julius Knapp  
Aspasia Paroutsas  
Jamison Prime  
Karen Rackley

**ATTACHMENT**



## 5 Radiated emissions in GPS receive band

### 5.1 Test Result

Test Description	Reference	Test Result
Radiated emissions in GPS receive band	15.519(d)	Compliant

### 5.2 Test Method

In addition to the radiated emission limits specified in the table in paragraph (c) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	EIRP dBm	EIRP (dBμV/m) at 3m	EIRP (dBμV/m) at 1m
1164–1240	-85.3	9.9	19.4
1559–1610	-85.3	9.9	19.4

### 5.3 Test Site

3m Absorber Lined Shielded Enclosure, SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.0°C

Relative Humidity: 32 %

### 5.4 Test Equipment

Test Date: 7-Dec-2015

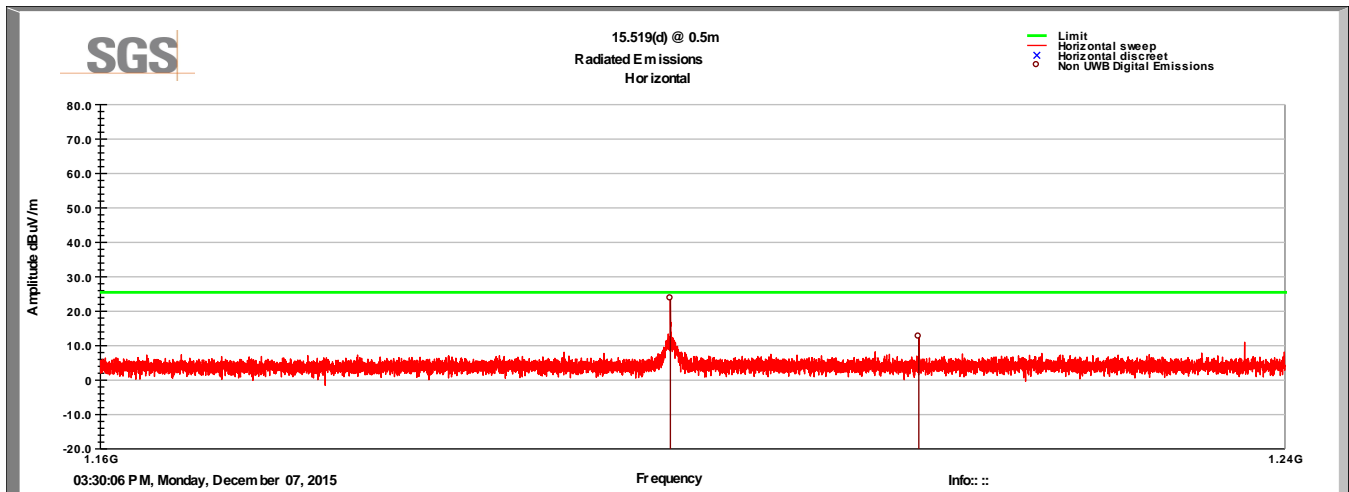
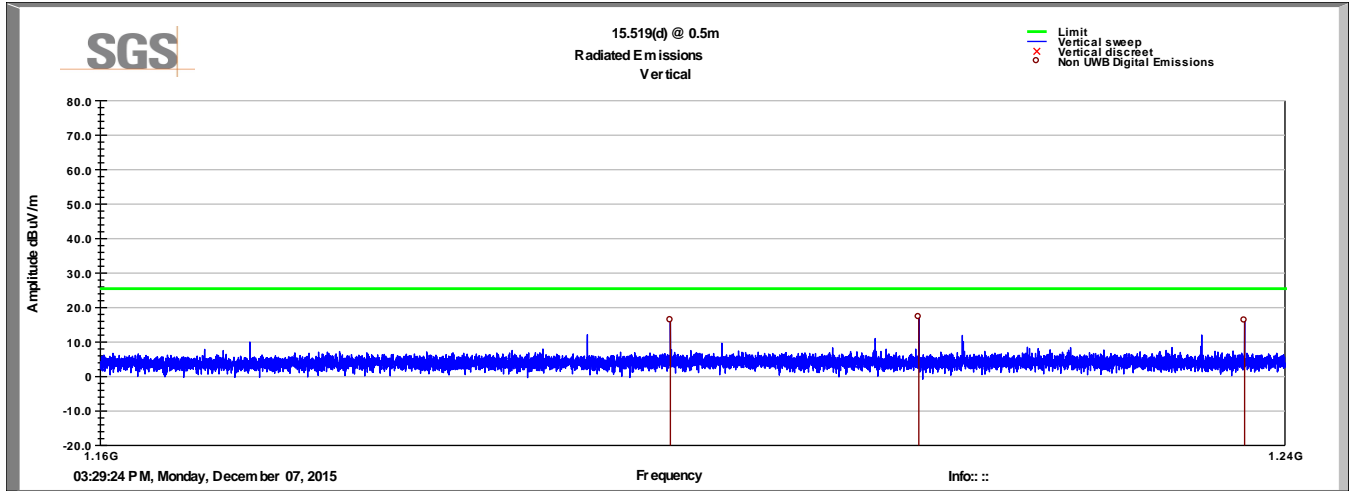
Tester: D Schramm

Equipment	Model	Manufacturer	Asset Number	Cal Due Date
EMI TEST RECEIVER	ESU40	ROHDE & SCHWARZ	B079629	4-Aug-2016
DRG HORN (MEDIUM)	3117	ETS-LINDGREN	B079691	9-Jul-2016
PREAMPLIFIER-ANTENNA SYS	TS-PR18	ROHDE & SCHWARZ	15003	24-Aug-2016
RF CABLE	NMS-290-236.2-NMS	FLORIDA RF LABS	B095020	4-Aug-2016
TYPE N CABLE	104PE	HUBER&SUHNER	B079793	4-Aug-2016
FILTER	LPM17270	MICRO-TRONICS	B093646	5-Aug-2016

Note: The calibration period equipment is 1 year.

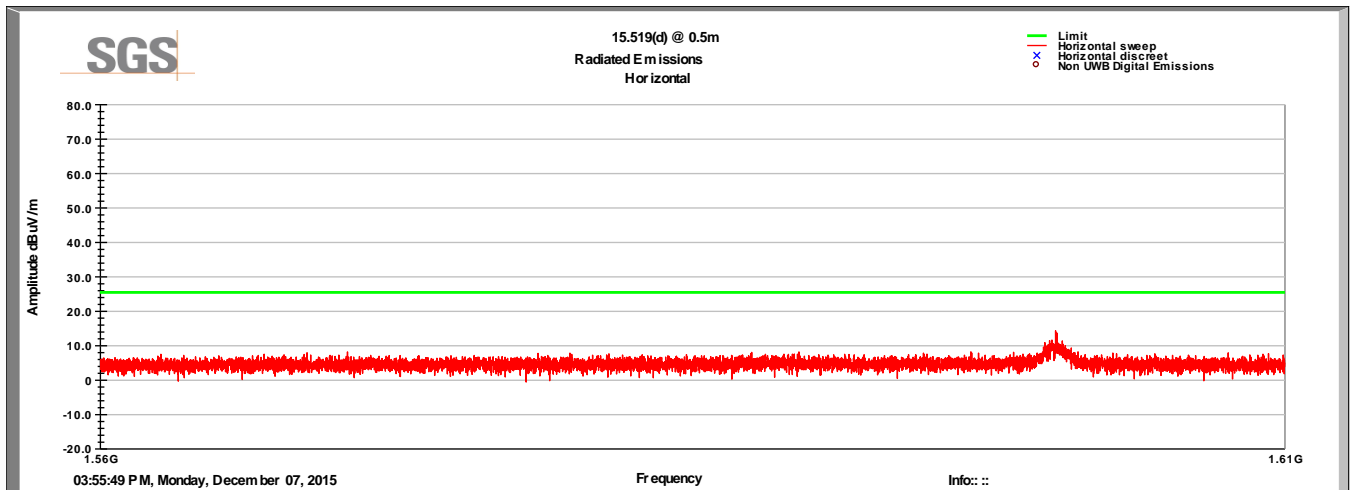
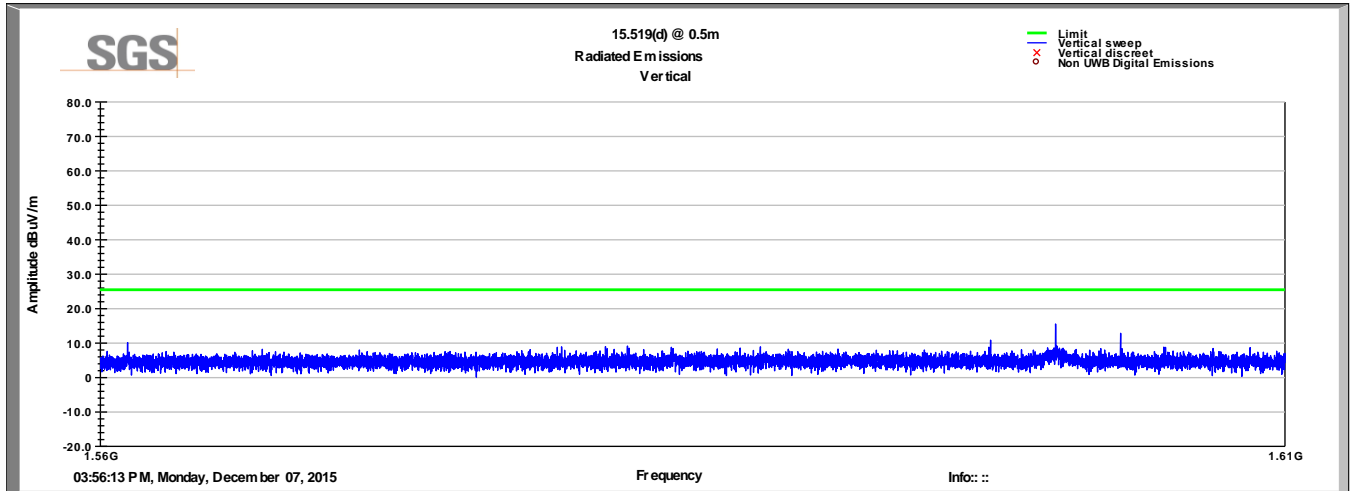
## 5.5 Test Data

### Radiated Emissions in lower GPS Receive Band



Digital Emissions not related to UWB intentional transmissions

Plot: Radiated Emissions in upper GPS Receive Band



## Data: Radiated Emissions in GPS Receive Bands

## Upper

Frequency MHz	Level dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	RMS Value dBuV/m	Limit (dBuV/m)	Margin dB
1583.65	15.6	V	107.0	100.0	29.2	2.5	40.4	6.9	19.4	-12.6

Frequency MHz	RMS Value dBm	Limit (dBm)	Margin dB
1583.65	-97.9	-85.3	-12.6

Frequency MHz	Raw RMS dBuV	Polarity (V/H)	Azimuth (degrees)	Height (cm)	AF (dB/m)	CL (dB)	Amp (dB)	RMS Value dBuV/m	Limit (dBuV/m)	Margin (dB)
1583.65	18.2	H	283.0	125.0	29.2	2.5	40.4	9.5	19.4	-9.9

Frequency MHz	RMS Value dBm	Limit (dBm)	Margin dB
1583.65	-95.2	-85.3	-9.9